prognosis. The patient's subsequent history was one of rapid progress. On January 31st his temperature became practically normal. Four days later I placed him on a soft diet, and on February 13th, thirty-five days after the onset of the arteritis, I first noted a return of pulsation in the right radial and brachial arteries. The pulse in each was slightly weaker and a trifle slower than in those of the left arm, but in three days I could detect no difference between the two sides. On this day he was placed on solid diet and was allowed to sit up. Shortly thereafter he was permitted to get up and walk about, and I released him from my care.

The urine examinations were negative throughout the course of the disease. I very much regret that I was unable to have another Widal reaction taken.

In considering this case, it seems best to regard the arterial complication as one of the so-called peripheral arteritides, as the symptoms so nearly correspond to those of this nature. The disappearance of the axillary pulsation and its speedy subsequent return may, however, be taken as an indication of the displacement of an axillary thrombus and its later lodgement in the bloodvessels of the brain. This would account for the extreme delirium, but the complete reestablishment of the radial and brachial pulsations is against the view of thrombus formation, and the symptoms of delirium may be well explained by the occurrence of his second relapse.

THE OCCURRENCE OF CELLS WITH EOSINOPHILE GRANULATION AND THEIR RELATION TO NUTRITION.[1]

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Many facts are known concerning the activities of the various wandering cells of the blood, yet the significance of few phenomena which they exhibit is clearly understood. Since Cohnheim showed that the polynuclear leukocytes migrate from the bloodvessels, numerous observations have demonstrated how important is the part played by these cells in the inflammatory changes which follow the invasion of bacteria. Nevertheless, we are ignorant of what they accomplish in resisting invasion of the body. Metschnikoff and his pupils believe that the polynuclear leukocytes with neutrophile granu-

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[1] The present investigation has been conducted with the aid of a grant from the Rockefeller Institute for Medical Research.

lation resist the infective agent by ingesting and destroying it, while other observers, notably Büchner, maintain that the leukocytes furnish something to the fluids which destroys the micro-organism before it is engulfed. The functional significance of the peculiar granules which stud the protoplasm of these polynuclear cells is obscure. Much less is known concerning the activities of a second type of granular leukocyte, the so-called eosinophile cell, and almost nothing is known of its functions. A short survey of its occurrence in various vertebrate species will furnish some indication of its importance.

It is well known that the studies inaugurated by Ehrlich have demonstrated in the leukocytes of the blood distinctive granules which exhibit peculiar affinities for certain dyes or for a whole group of chemically related dyes. Those dyes of which the staining principle is a base distinguish the granules which are characteristic of certain cells. Another kind of granule is stained only by acid dyes. Neutrophile granules, according to Ehrlich, are stained by the neutral mixture of an acid and a basic stain. By the size of the cell, the shape of its nucleus, and the character of the granules scattered in its protoplasm, the various cells of the blood are classified.

By the microscopic study of fresh blood, Wharton Jones[1] was able to distinguish cells with coarse refractive granules, which many subsequent observers believed to be droplets of fat. These coarse granules occupied the attention of Ehrlich[2] at the outset of his studies upon the staining reactions of protoplasmic granulation. He demonstrated that they are readily stained by all acid dyes, but have such a marked affinity for eosin that when treated with various mixtures of this stain with other acid dyes, they take up it alone. In human blood these so-called eosinophile cells contain a polymorphous nucleus and are actively amœboid, resembling in these characters the more numerous leukocytes, which contain finer neutrophile granules. Eosinophile leukocytes were found by Ehrlich not only in the blood of man and other mammals, but in that of the frog as well, while subsequent studies have demonstrated that they are very widely distributed in the animal kingdom.

ZOOLOGICAL DISTRIBUTION OF CELLS WITH EOSINOPHILE GRANULATION. Comparative studies of Hirschfeld[3] and others have shown that two types of leukocyte with polymorphous nucleus, are present in the blood of all mammalian species. That variety which in almost all mammals constitutes a majority of the white corpuscles and migrating from the bloodvessels plays a very important part in inflammatory processes is provided with relatively fine granules, which exhibit an affinity for acid dyes. Since the common polymorphonuclear leukocytes of human blood contain granules which exhibit a peculiar reaction to a mixture of certain acid and basic dyes, but have a well-marked affinity for acid stains, they have been designated by Kanthack and Hardy[1] finely granular acidophile or oxyphile leukocytes. The amphophile granules of Ehrlich present in the polynuclear leukocytes of rabbits are stained by both acid and basic dyes. According to Hirschfeld, the more common polynuclear leukocytes of one mammal, the white mouse, exhibit no granulation, but Ehrlich and Lazarus[2] are inclined to doubt this statement.

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[1] Philosophical Transactions, London, 1864, p. 63.

[2] Verhandlungen der physiologischen Gesellschaft, Berlin, 1878-79, No. 20.

[3] Virchow's Archiv, 1897, vol. cxlix. p. 22.

Common to all mammalian species examined by Hirschfeld are leukocytes with coarse, acidophile granules. These granules usually exhibit an especial avidity for eosin and are stained by it alone when treated with mixtures containing other acid dyes. Hirschfeld has found that the coarse, acidophile granules of a few animals exhibit a slight modification of this reaction. In the dog and in the cat they take a mixed tint when treated with eosin and aurantia, while in the horse they are stained by eosin and indulin in combination.

Grünberg[3] and Meinertz[4] have studied the white corpuscles of birds, reptiles, amphibia, and fish by the methods introduced by Ehrlich. Small mononuclear cells, with basophile protoplasm free from granules, the lymphocytes of mammalian blood, occur in the various species examined, and forms with polymorphous nucleus are almost constantly found. The latter often contain granules which exhibit an affinity for acid or basic dyes. Cells with acidophile granules are very widely distributed, and in some birds and reptiles constitute a majority of the white corpuscles present in blood. In birds occur two varieties of acidophile granules, both of which show a strong affinity for eosin: (*a*) round or oval bodies, and (*b*) peculiar, elongated, spindle-shaped, or crystalloid particles. The latter occur in all birds and in certain reptiles. In the frog the greater number of polynuclear leukocytes are free from granulation, but a minority are studded with round, eosinophile bodies; crystalloid forms are absent. In fish the characters of the white corpuscles and of the granulation they exhibit are very variable. Acidophile granules are frequently found, but often differ in size, shape, and staining reaction from those of higher species. Certain Teleostean fish, for example, Gobio fluviatilis (Mesnil)[5] and Perca fluviatilis (Mesnil and Meinertz), possess no granular leukocytes.

The constant presence among mammals of two types of polynuclear leukocyte, one type being constantly more numerous than the other, suggests the possibility that each form has a peculiar functional significance. In lower vertebrates, namely, in birds, reptiles, amphibia, and fish, this constantly recurring relation is not present.

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[1] Journal of Physiology, 1894, vol. xvii. p. 81.

[2] Normale und pathologische Histologie des Blutes, Nothnagel's spec. Path. u. Ther., 1900, Bd. viii. Teil, 1.

[3] Virchow's Archiv, 1901, vol. clxiii. p. 303.

[4] Ibid., 1902, vol. clviii. p. 353.

[5] Annales de l'Inst. Pasteur, 1895, vol. ix. p. 301.

Moreover, the color reactions first described by Ehrlich, being doubtless dependent upon certain chemical or physical peculiarities of the specific granulations, afford no proof that structures in widely separated species are anatomically or functionally homologous.

Hence, while the eosinophile cells of mammals, bearing a constant relation in different species, are, doubtless, analogous structures, even though they occasionally present slight variation in their staining reactions, they are not necessarily comparable in function; and other characters to the cells with acidophile or eosinophile granules of lower vertebrates. Such assumption seems to have been made by several writers, who have studied, experimentally, the activities of certain granular leukocytes in frogs and in fish.

Cells with eosinophilic granules form in man a small proportion of the total number of leukocytes; their relative number has been found somewhat variable. Ehrlich[1] has stated that they usually constitute from 2 per cent. to 4 per cent. of the leukocytes, and rarely reach as much as 10 per cent. The figures given by other observers vary within these limits. Zappert,[2] who has very carefully counted the eosinophile leukocytes of healthy individuals, finds the proportion noted by Ehrlich, but, preferring to estimate their absolute number, states that 50 to 250 are usually present in one cubic millimetre of blood, though they may reach 700. In children he found that they are usually more numerous than in adults.

In certain mammals the numerical relation of the eosinophile leukocytes to other forms varies within wider limits. In few species has the proportion been accurately determined. Nevertheless, in two widely separated mammals, namely, in the rabbit and in the dog, accurate counts have been made in the course of repeated experimental studies. Kanthack and Hardy found 1 per cent. to 2 per cent. of eosinophile (oxyphile) cells in the blood of the rabbit; Tallqvist and Willebrand,[3] 0.5 per cent. to 2.8 per cent.; Brinkerhoff and Tyzzer,[4] 0.5 per cent. to 1 per cent. The proportion of eosinophile cells in the dog's blood shows greater variation, and the normal average is higher. In fifteen animals, counts made by Tallqvist and Willebrand varied between 0.2 per cent. and 8.1 per cent., the average being 5.3 per cent. In ten animals Dawson[5] found a minimum count of 2.6 per cent. and a maximum of 21.6 per cent. The individual counts which Dr. Dawson has kindly placed at my disposal are as follows: 6.6 per cent., 12.2 per cent., 3.2 per cent., 2.6 per cent., 21.6 per cent., 4.6 per cent., 5 per cent., 10.8 per cent., 9.4 per cent., 2.6 per cent.

In several instances the count is so much above that obtained from the other animals and from those studied by Tallqvist and Willebrand that the presence of some pathological process to explain the apparent eosinophilia has been suspected. The frequency with which dogs are infected with animal parasites is well known, and uncinaria caninis is found with great frequency in the small intestine. With these facts in view, I have studied the blood of ten apparently healthy dogs, and have subsequently examined the intestines and other organs.

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[1] Charité-Annalen, 1888, vol. xiii.

[2] Zeit. f. klin. Med., 1893, vol. xxiii. p. 227.

[3] Skandinavisches Arch. f. Phys., 1900, vol. x. p. 37.

[4] Journal of Medical Research, 1902, vol. vii. p. 173.

[5] American Journal of Physiology, 1900, vol. iv.

TABLE I.

No.	Leukocytes in 1 c.mm.	Eosinophiles in 1 c.mm.	Parasites in small intestine.
1	15,100	1208 = 8.0 %	U. caninis (3), tænia cucumerina (10 grm.).
2	22,350	939 = 4.2 "	U. caninis (25 to 50) and several tapeworms.
3	16,600	880 = 5.3 "	U. caninis (3), ascaris marginata (1), and small tapeworms in large numbers.
4	15,800	632 = 4.0 "	U. caninis (12) and several tapeworms.
5	10,700	567 = 5.3 "	T. cucumerina (large amount), A. marginata (3).
6	15,400	493 = 3.2 "	T. serrata (large amount).
7	14,200	454 = 3.2 "	Several small tapeworms.
8	16,400	328 = 2.0 "	A. marginata (10) and two tapeworms.
9	19,700	197 = 1.0 "	U. caninis (3).
10	5,800	24 = 0.5 "	

The figures are inconclusive, since in no instance does the proportion of eosinophile cells equal that noted by Dawson. Nevertheless, they afford a basis for further comparison and suggest, at least, that the absolute number of eosinophile cells bears some relation to the number of animal parasites within the intestinal tract, especially when it is noted that the smallest number of eosinophile cells was found in two animals, one of which contained three parasites (No. 9), while the other (No. 10) was free from infection.

METHODS. Few observations have been made upon the occurrence of eosinophile leukocytosis in lower animals, and while in a few instances experimental eosinophilia has been produced, the progress of the phenomenon has seldom been recorded by repeated differential counts, which are very laborious and time-consuming. In order to avoid, in some part, this difficulty, and at the same time to obtain a great number of observations upon the behavior of the eosinophile cells under a considerable variety of conditions, I have adopted the simple method of counting the leukocytes in fresh blood. Hardening and staining being obviated, the results are of necessity obtained without delay.

A drop of blood is allowed to spread between cover-slip and slide and is immediately examined with the oil immersion lens ($\frac{1}{12}$ obj.). Certain precautions are essential in order to make the white corpuscles so conspicuous that none are missed in counting. Of first importance is the use of artificial illumination, preferably that from the so-called Welsbach burner, since by this means the refraction of the corpuscles is increased and the characters of their granulation and of their nuclei become evident. A diaphragm with a rectangular opening is so inserted into the eye-piece of the microscope that the upper and lower segments of the field are obliterated and the count, performed with the aid of a mechanical stage, is confined to a somewhat narrow equatorial zone. It is obviously necessary to use only those specimens in which the blood is spread into a moderately thin layer, and to make the count immediately after the blood is drawn.

If these precautions are taken, on the one hand, few, if any leukocytes, are omitted from the count, while, on the other hand, the individual forms, notably the highly refractive eosinophile cells, are recognized with ease and their relative number noted. In most instances this percentage count was limited to the eosinophile cells, since they alone occupied attention and numerous observations, consuming much time, were necessary. As a routine the number of eosinophile cells in 300 or 400 leukocytes was determined. The character of the charts, which will be subsequently described, sufficiently vindicate the accuracy of the method and show that, even though it may not be absolutely exact, it gives an adequate presentation of the changes which the eosinophile leukocytes undergo. For comparison, I have counted by both methods specimens from five guinea-pigs and from five healthy men.

	Fresh specimen.	Hardened specimen.[1]
From guinea-pig	15.3	14.0
“ “	8.7	10.2
“ “	6.7	5.0
“ “	1.7	3.0
“ “	1.3	0.5
“ healthy man	10.0	8.4
“ “	3.3	3.2
“ “	2.7	2.7
“ “	2.0	2.6
“ “	1.3	3.7

The proportion of eosinophile cells noted in the fresh specimen is not with constancy greater or less than that obtained from the hardened film. Doubtless the ordinary method of counting hardened and stained specimens is accurate only within certain limits. Thus, Boycott and Haldane,[2] making for the sake of comparison successive differential counts of 1000 cells in the same film, found in two cases the following figures for the neutrophiles in four successive thousands of white corpuscles:

59.2	55.5	55.2	53.6 %
35.8	32.7	38.7	34.8 “

For the purpose of certain experiments not included in the present paper, the guinea-pig was found more available than either the rabbit or the dog. Blood can be repeatedly obtained from the peripheral circulation by puncturing the skin of the ear or by nicking with sharp scissors the edge of the ear after clipping the hair.

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[1] For assistance in counting these specimens I am indebted to Dr. Ernest Cullen.

[2] Journal of Hygiene 1903, vol. iii. p. 95.

It was soon found that the number of eosinophile leukocytes was so variable that a preliminary study of the conditions which influence them was necessary. Even though the facts concerned refer to a single species, they are, I believe, of sufficient general interest to justify a detailed study.

EOSINOPHILE CELLS OF THE BLOOD. The white corpuscles of the guinea-pig, which have been the subject of special study by Kurloff,[1] present several noteworthy peculiarities. In briefly describing the various types, I will mention characteristics observable in the freshly drawn blood. The following forms occur:

1. Polynuclear leukocytes with fine acidophile granulation constitute, Kurloff states, 40 per cent. to 50 per cent. of the total number of white cells. According to Ehrlich and Kurloff, the granulation is of the pseudoeosinophile or amphophile type, but Hirschfeld denies this statement and claims that the granules stain only with acid dyes, and, preferably, with indulin.

2. Eosinophile cells are readily recognized in fresh blood by their coarse, round, or oval, very refractive granules of somewhat greenish tint; they are very actively amœboid. In stained specimens the nucleus is often found to be horseshoe-shaped or trilobed, while all transitions between the two occur.

3. Basophile cells can be identified in the fresh specimen. They are filled with coarse, oval granules, which are easily distinguished from those of the eosinophile cell, being of greater size and only slightly refractive. These cells are actively amœboid at temperatures approximating that of the body.

4. Lymphocytes resembling those of human blood constitute, according to Kurloff, 30 per cent. to 35 per cent. of the total number of white corpuscles. Large and small mononuclear cells occur. I have frequently observed amœboid movement, but it is much less active than that of the forms previously mentioned. A short protrusion of the protoplasm occurs at one point. The projection becomes larger and knob-like, constricted where it joins the remainder of the cell. This constriction persists and passes like a wave from one side of the cell to the other as the projecting protoplasm increases at the expense of that which remains.

5. Vacuolated cells peculiar to the guinea-pig have been described by Kurloff and represent a considerable proportion of the mononuclear leukocytes. Within the protoplasm are one, or, occasionally, two globules, which, in fresh specimens, have a homogeneous, greenish color, and are more refractive than the cell protoplasm; the globule is frequently larger than the nucleus of the cell. Such vacuolated cells are inactively amœboid.

In order to obtain a basis for comparison, the occurrence of eosinophile leukocytes in the blood of normal guinea-pigs has been studied and their distribution in the internal organs has been observed. Kurloff states that eosinophile cells constitute only 1 per cent. of the white corpuscles of the blood; Kanthack and Hardy give the proportion as 2 per cent. to 3 per cent. Finding these figures much exceeded in many apparently healthy animals, I have been inclined to suspect the presence of some latent pathological process. Post-mortem examination has failed to confirm this suspicion, though the possibility cannot be excluded with certainty. The intestine of the guinea-pig is subject to infection with several protozoan parasites, which apparently produce no noteworthy alteration of health. In the small intestine one not infrequently encounters the flagellate parasite, megastoma entericum, while in the cæcum infusoria are almost constantly present, often in considerable number. No relation was established between the presence of these protozoan forms and the occurrence in the blood of eosinophile leukocytes in unusually large numbers. The frequency with which eosinophile cells are found in the lungs, and notably in the wall of the bronchi, has directed especial attention to these organs. The relation of the eosinophile cells in the blood to those of the bronchi will be considered later.

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[1] Quoted by Ehrlich and Lazarus.

Animals with high eosinophile count have been often found to be especially large, healthy specimens, and, indeed, a relation between the number of eosinophile cells and the weight of the animal is readily established. In the following table, in which the animals are ranged according to their weight, is recorded the preliminary count made upon many healthy animals previous to performing various experiments:

TABLE II.

Wt.	Eo. %	Wt.	Eo. %	Wt.	Eo. %	Wt.	Eo. %	Wt.	Eo. %	Wt.	Eo. %
299	0.6	398	0.0	481	1.3	546	16.0	667	2.3	785	19.3
287	0.0	363	0.3	436	0.3	509	0.0	615	1.5	788	15.0
		309	0.0	400	1.5	501	1.0	653	3.3	718	8.7
		385	0.3	454	0.3	556	1.3	622	4.0		
		366	1.7	423	1.3	597	29.0	649	15.3		
		345	1.7	418	0.0	567	5.7	665	9.0		
				494	0.0	586	6.7	622	36.3		
				497	0.0	578	5.7	604	10.3		
				406	0.5	532	9.7	650	7.3		
				415	0.0	588	6.8	625	24.3		
				487	5.7			672	1.5		
								697	15.0		
								641	18.0		
								604	8.3		
Mean,	0.3		0.6		1.1		8.2		11.2		14.3

In the foregoing table certain facts are noteworthy. In animals weighing less than 500 grams the proportion of eosinophile leukocytes rarely exceeds 2 per cent., and agrees approximately with that found by Kurloff and by Kanthack and Hardy; but in animals of greater weight a much higher percentage is almost constant. Even where the animal weighs more than 500 grams the proportion is occasionally less than 2 per cent., but the mean for animals of this weight is much higher. The averages have been calculated from the figures in the various columns of the table, each of which, from left to right, represents an increase of 100 grams. After a very slight gradual increase in the proportion of eosinophile cells, reaching 1.1 per cent. for animals weighing from 400 to 500 grams, there is a sudden rise to 8.2 per cent. in the next column, followed by a more gradual increase in the columns containing guinea-pigs of greater weight. The animals, which in almost every case had been obtained from dealers only a short time before examination was made, had doubtless been subjected to varying conditions of nutrition. This fact, as will be subsequently shown, may account for some variation in the percentage of eosinophile leukocytes.

The great variation to which the number of eosinophile leukocytes in the blood of apparently healthy guinea-pigs is subject is further shown by the following table, in which in ten instances their number in one cubic millimetre of blood has been calculated from the total number of leukocytes:

TABLE III.

No.	Weight.	Leukocytes in 1 c.mm.	Eosinophiles in 1 c.mm.
1	454	8,100	24 = 0.3 %
2	521	8,700	1479 = 17.0 "
3	532	10,600	1028 = 9.7 "
4	556	16,600	249 = 1.5 "
5	578	24,200	1379 = 5.7 "
6	625	8,500	2916 = 34.3 "
7	650	12,500	913 = 7.3 "
8	690	15,700	1649 = 10.5 "
9	695	13,900	2127 = 15.3 "
10	718	10,800	940 = 8.7 "
Mean		12,960	1270 = 11 0 "

The total number of leukocytes varies within such wide limits that the proportion of eosinophile cells allows only a rough estimation of their absolute number. Nevertheless, if the figure which represents the percentage count is multiplied by 115 (the mean number of eosinophile leukocytes in one cubic millimetre of blood divided by the mean percentage count), a figure approximating the absolute number of eosinophile leukocytes is obtained. Hence the facts demonstrated by Table II. are applicable to the absolute as well as to the relative number of these cells.

EOSINOPHILE CELLS IN THE TISSUES. The distribution of eosinophile cells in the organs of the guinea-pig still further indicates that they play a very important part in metabolism. Heidenheim[1] has shown with what frequency these cells are found in the mucosa of the dog's intestine, while Teichmüller[2] has emphasized their abundance in the lungs. Their distribution in the organs will be briefly described.

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[1] Pflüger's Arch. f. Phys., 1888, vol. xliii. Suppl. Hft.

[2] Deutsches Arch. f. klin. Med., 1898, vol. lx. p. 576.

Throughout the gastrointestinal tract eosinophile cells occur in great abundance and are most numerous in that part of the mucous membrane which is between and immediately below the tubular glands. They are readily recognized in sections stained with eosin by their large, oval, brilliantly red granules. They do not differ from the eosinophile leukocytes of the blood and are provided with nuclei which are trilobed, bilobed, or horseshoe-shaped.

In the superficial part of the gastric mucosa eosinophile cells are scant, but are very numerous between the ends of the glands and in the narrow zone between the glands and the muscularis mucosæ. In the submucosa immediately below the muscularis mucosæ they are again abundant, but elsewhere in the connective tissue of the gastric wall are rarely found.

Throughout the mucous membrane of the small intestine eosinophile cells are found between the bases of the glands of Lieberkühn, in the subglandular tissue which lies between these glands and the muscularis mucosa, but are scant in the villi and in the submucosa. Such cells are especially numerous in the mucosa overlying the Peyer's patches. In the guinea-pig a diverticulum of the superficial epithelium extending downward is situated just above each constituent follicle, and in the lymphoid tissue lying between two such diverticula eosinophile cells are not infrequently so numerous that they give a red color to the tissue examined with the low power of the microscope. In the mucosa of the large intestine, and especially in the cæcum, cells with eosinophile granules are numerous between the bases of the glands.

In the walls of the trachea, the bronchi, and the subdivisions of the latter eosinophile cells are found in considerable number; in the connective tissue surrounding the bronchi and the bloodvessels similar cells occur, while not infrequently they are present in the interalveolar walls outside the capillary vessels.

Of considerable interest is the readily demonstrable fact that eosinophile cells penetrate through the epithelium into the lumen of the small bronchi. Scattered in the loose areolar tissue of the mucosa may be found cells with eosinophile granulation, and between the columnar cells of the epithelium similar eosinophile cells are easily recognized, while others have made their way into the lumen of the bronchus. Cells with scant, partially disintegrated protoplasm, containing a somewhat irregular nucleus, are usually more numerous in the same situation. The possibility that some of these nuclei represent the remains of eosinophile cells altered by the bronchial secretions has occasionally suggested itself, but the occurrence of such transformation has not been demonstrable.

Eosinophile cells are at times even more numerous in the fibrous tissue external to the muscle than in the mucosa. Should a small nodule of lymphoid tissue occur in this situation, eosinophile cells show an especial tendency to accumulate in the part of the nodule which is next the lumen of the bronchus and in the tissue immediately overlying. Throughout the external coat of connective tissue eosinophile cells are numerous. A specimen in which eosinophile cells were particularly numerous has served to explain the origin of these cells, for in the small bloodvessels of the bronchial wall they are very numerous, probably held here by some chemotactic influence. They doubtless emigrate not only from the small veins of the connective tissue, but from the alveolar capillaries in the immediate neighborhood of the bronchus, for in these vessels they are present in much greater numbers than in the interalveolar capillaries more distant from the bronchus.

The passage of eosinophile leukocytes into the bronchi probably exerts an influence upon the number of eosinophile cells in the blood. Examination has not been made in a sufficiently large number of animals to determine the relation of the process to the eosinophilia noted in apparently normal guinea-pigs. In six of nine animals I have found eosinophile cells within the lumina of the bronchi; *the weight and proportion of eosinophile cells in the blood* were as follows: (1) 650 grams, 7.3 per cent.; (2) 625 grams, 24.3 per cent.; (3) 622 grams, 36.3 per cent.; (4) 604 grams, 8.3 per cent.; (5) 556 grams, 1.5 per cent.; (6) 521 grams, 17 per cent. In the three remaining animals no eosinophile leukocytes were found within the bronchi; their weight and percentage of eosinophile leukocytes were as follows: (7) 643 grams, 5.7 per cent.; (8) 454 grams, 0.3 per cent.; (9) 390 grams, 0.5 per cent.

In large, apparently healthy animals eosinophile cells migrate from the bloodvessels into the bronchi, and there is, as far as I have found, no additional evidence that the bronchi are the seat of a pathological process. The significance of this migration is not apparent.

Below epithelial surfaces other than those of the intestine and air-passages, eosinophile cells are rarely found. They do not accumulate below the squamous epithelium of the normal skin, nor of the tongue, in the mucosa of the bladder, nor in the walls of the ducts of the liver, pancreas, or testicles.

Kanthack and Hardy claim that the connective tissue is the especial habitat of the coarsely granular oxyphile cell, yet only in certain localities are they constantly present in considerable number. Cells with eosinophile granulation are infrequently observed in the subcutaneous areolar tissue, in the fascia and septa of muscles, and in the connective tissue of the liver, kidneys, adrenal glands, pancreas, thyroid, and testicles. In the serous membranes, the omentum and the mesentery, on the contrary, eosinophile cells are fairly numerous and are distributed in greatest number along the course of the small bloodvessels. Within the serous cavities, as Kanthack and Hardy have shown, these cells are constantly present and constitute from 30 per cent. to 50 per cent. of the total number of cells in the peritoneal fluid of the normal guinea-pig.

Little attention has been paid to the intimate relation which exists between the lymphatic apparatus and the eosinophile cells. Their abundance in the lymphoid tissue of the gastrointestinal mucosa has already been noted and attention has been directed to their accumulation in the Peyer's patches of the small intestine and in the lymphoid follicles of the bronchi. Their presence in the serous cavities is noteworthy. They are, moreover, constantly present in the lymphatic glands, not only in those at the base of the mesentery, but in the peripheral glands, such as those in the inguinal region as well. Eosinophile cells are not found within the follicles which occupy the cortex of the gland, but are fairly abundant at the periphery of the follicles, near and at times within the peripheral sinus. Within the sinuses of the medulla eosinophile cells occur in small numbers, but in the medullary cords they are more numerous and are not infrequently ranged along the margins of the sinuses.

In the connective tissue in the immediate periphery of the lymphatic glands eosinophile cells are often found in abundance, and their number diminishes as the distance from the gland increases. In one specimen, by a fortunate accident, I obtained evidence that these cells are derived not from the gland, but directly from the blood. Cells with eosinophile granulation were here numerous, both in the tissue and in the small veins, and had been actually fixed in process of migration from the latter. In several instances elongated eosinophile leukocytes had partially penetrated the endothelium of the vessel, part still remaining within the lumen.

In the bone-marrow cells, with coarse eosinophile granulation, are more numerous than in any other organ of the healthy animal. Here alone are found the large mononuclear eosinophile cells described by H. F. Müller and Rieder.[1] They are analogous to the myelocytes of Ehrlich, which are essentially cells of the bone-marrow and only in leukæmia find their way into the general circulation. The myelocyte with eosinophile granulation is considerably larger than the eosinophile leukocyte, and is provided with a large round or oval, often irregularly indented nucleus. In sections of marrow hardened in Zenker's fluid the nuclear membrane stains deeply with hæmatoxylin, giving a vesicular appearance to the nucleus, but chromatic substance is not abundant, so that the nucleus, particularly in dried preparations, stains palely. Müller and Rieder have shown that these cells are capable of little if any amœboid movement.

In addition to myelocytes with eosinophile granulation, smaller eosinophile cells with polymorphous nuclei are present in the bone-marrow. Many of these are identical with the eosinophile leukocytes of the blood and are capable of amœboid movement. Cells of the same size may contain a rounded nucleus, which is usually kidney-shaped as the result of an indentation at one point. Other small eosinophile cells have a nucleus which has the form of a bent rod; constrictions at intervals so divide the rod that it is transformed into the lobed nucleus which is found in the eosinophile leukocytes of the circulating blood.

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[1] Deutsches Arch. f. klin. Med., 1891, vol. xlviii. p. 47.

Mitotic division of eosinophile cells in mammals was first described by H. F. Müller,[1] though similar observations had been made by Flemming[2] and Dekhuysen[3] in amphibia and birds. Such division in the guinea-pig takes place only in the bone-marrow and occurs in cells which are usually so large that they are recognized as myelocytes.

Corresponding to the varying number of eosinophile cells in the circulating blood of guinea-pigs, the bone-marrow exhibits variations which help to explain the origin of these cells. In animals of which the blood during life contains approximately 1 per cent. of eosinophile leukocytes fat is very abundant and the cells of the marrow occupy the interstices between the fat-cells. Eosinophile cells of the characters already described occur in moderate numbers scattered among the other cellular elements. In animals with a larger proportion of eosinophile cells in the blood, similar cells are more numerous in the marrow, but in guinea-pigs in which the eosinophile cells of the blood reach the proportion of from 15 per cent. to 30 per cent. the bone-marrow presents a characteristic appearance. The fat is in great part or wholly replaced by myeloid tissue, which is largely composed of cells with eosinophile granules. Myelocytes are particularly numerous, but smaller cells with polymorphous nucleus are not wanting. Eosinophile cells in process of mitotic division are readily recognized by the hyperchromatic condition of the nucleus, and never in large numbers, are much more numerous than usual; the so-called diaster stage of mitosis is not infrequent.

In the pulp of the spleen eosinophile cells are found in considerable number, and are more abundant the greater the number in the circulating blood. They are absent within the Malpighian corpuscles, but are particularly abundant in the pulp at their periphery. Eosinophile myelocytes do not occur and mitotic figures are not demonstrable.

RELATION OF THE EOSINOPHILE CELLS TO NUTRITION. In apparently healthy guinea-pigs weighing more than 500 grams, eosinophile leukocytes, as it has been shown, not infrequently form from 15 per cent. to 30 per cent. of the total number of leukocytes, and in the greater number of instances constitute 8 per cent. to 14 per cent. In this animal, more readily than in man, where the eosinophile cells rarely exceed 4 per cent., it is possible to determine the conditions with which these cells are diminished, as well as those with which they are increased.

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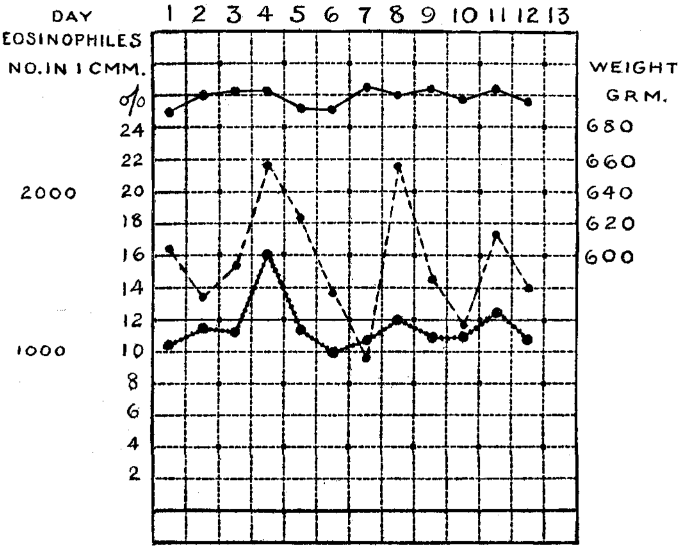
[1] Arch f. exper. Path. u. Phar., 1892, vol. xxix. p. 221.

[2] Arch. f. mik. Anat., 1891, vol. xxxvii. p. 249.

[3] Anat. Anz., vol. vi. p. 220.

It was considered desirable to make a preliminary study of the changes to which the eosinophile leukocytes may be subject under ordinary conditions. For this purpose the blood of guinea-pigs supplied with abundant food and water were examined repeatedly for a considerable period of time, and variations in the number of eosinophile cells were noted. The animals were allowed to feed at will and no allowance was made for a possible leukocytosis of digestion. The records which follow indicate that such leukocytosis is not an important disturbing factor. The weight of the animal serves as the best indication of its condition and has been recorded in conjunction with the count of eosinophiles.

CHART 1.

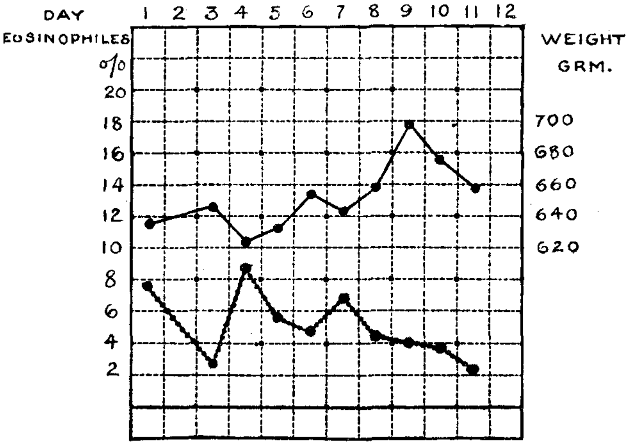


In this and in the charts to follow the percentage of eosinophile cells is represented by a dotted line, their number in one cubic millimetre of blood by a broken line. The weight of the animal is represented by a black line.

In Chart 1 are recorded the weight of the animal, the proportion of eosinophile cells in the blood, and their absolute number in one cubic millimetre of blood, calculated from the total number of leukocytes, which have been estimated daily by means of a Thoma-Zeiss apparatus. During twelve days the weight has varied little, ranging from 690 to 705 grams. The proportion of eosinophile cells exhibits slight variations, which correspond fairly well to much more marked alterations of their absolute number. At intervals of several days there is a recurring increase in the number of these cells, as though many were rapidly thrown into the circulation. The sudden elevation of the curve is followed by a somewhat more gradual fall.

In Chart 2 only the weight and proportion of eosinophile cells are recorded.

CHART 2.



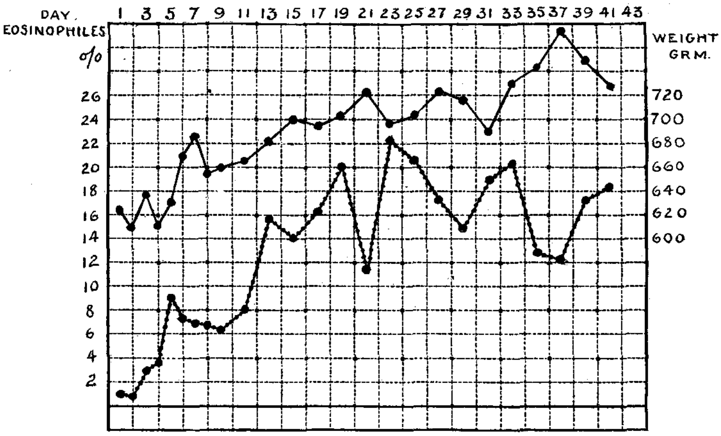
The weight of the animal varies within wider limits than that recorded in Chart 1, and, as in the previous instance, the proportion of eosinophile cells alternately increases and decreases. A comparison of the two curves suggests that the number of eosinophile cells bears a relation to changes in the weight of the animals, for repeatedly an increase in weight is accompanied by a fall in the proportion of eosinophiles, while a decrease of weight is accompanied by an increase in the number of these cells, so that the two curves tend to vary in opposite directions. This phenomenon is not constant, for on the tenth and eleventh days, though the weight has fallen, the eosinophiles do not rise. Doubtless, conditions other than those which affect nutrition exert an influence on the proportion of eosinophile cells, and in Chart 1, though the number of eosinophile leukocytes varied considerably, the weight changed little.

A relation between variations in weight and proportion of eosinophile cells is even better indicated in the following curve, where the eosinophile leukocytes rose gradually during a period of nearly three weeks. Alterations of the number of eosinophile cells, with much constancy, take an opposite direction from those of weight, and at times these contrary variations extend over a period greater than a week.

There was reason to suspect that the animal of which the number of eosinophile cells is recorded in Chart 3 had received, just before these observations were begun, an insufficient amount of food. The possibility has suggested itself that the food supply may exert an influence upon the eosinophile leukocytes of the blood.

By the use of Ehrlich's triple stain somewhat modified Heidenhain demonstrated the existence of cells with deep-red granules, undoubtedly eosinophile cells, in the villi, and still more abundantly in the subglandular layer of the dog's intestinal mucosa, and studied these cells under varying conditions of nutrition. If animals were starved during from four to seven days and then killed, eosinophiles disappeared from the villi and their number in the subglandular layer was diminished. Considerable variation was noted in individual cases, and in one instance eosinophile cells were numerous even after some days without food. Abundant feeding produced the opposite condition; if a dog receiving an ordinary diet was given a large meal of meat and was killed fourteen to sixteen hours later eosinophile cells were found in very large numbers, both in the villi and in the subglandular layer. Sugar in large amount had the same effect as proteid diet. Continued overfeeding diminished rather than increased the number of cells with eosinophile granulation.

CHART 3.



Teichmüller repeated with guinea-pigs some of the experiments of Heidenhain. He found that starvation causes the number of eosinophile cells in the intestinal mucosa to diminish, but thought that the number in the spleen was increased. If, however, the animal was killed by starvation, eosinophiles were diminished in the intestine, spleen, and bone-marrow. Hence, he reached the conclusion that starvation causes a temporary increase of eosinophile cells, followed by diminution of their number.

As far as I have been able to determine, observations upon the eosinophile cells of the blood during starvation have been made only by Tanszk,[1] who observed the fasting juggler Succi. An increase in the proportion of eosinophile leukocytes was noted.

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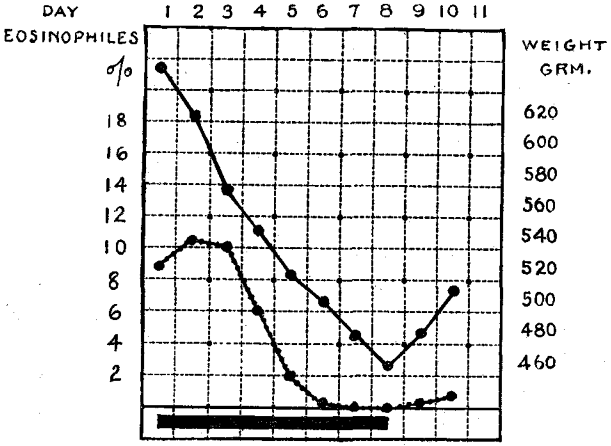
[1] Wiener klin. Rundschau, 1896, No. 18. Quoted by Teichmüller.

Following the suggestion offered by Chart 3, I have studied the effect which withdrawal of food exerts upon the eosinophile leukocytes of the circulating blood. The consequent changes are well shown in the following chart.

CHART 4.



In this and in the charts to follow the period during which the animal received no food is indicated by a broad black line at the bottom of the chart.

Though the weight diminished continuously from the beginning of the experiment, there was a primary increase in the proportion of eosinophile leukocytes, but after the third day they also decreased in number, and on the seventh and eighth days none were found in the specimens of blood which were examined. Estimation of the total number of leukocytes in conjunction with the proportion of eosinophile cells in two animals from which food was withheld has shown that diminution of the absolute number of eosinophile cells is accurately represented by the preceding chart, which records only their relative number.

GUINEA-PIG A.

Day.	Weight, grm.	Leukocytes in 1 c.mm.	Eosinophiles in 1 c.mm.
1st	712	11,900	1428 = 12.0 %
2d	677	8,600	1075 = 12.5 "
3d	645	14,200	2087 = 14.7 "
4th	619	10,600	1325 = 12.5 "
5th	594	15,500	852 = 5.5 "

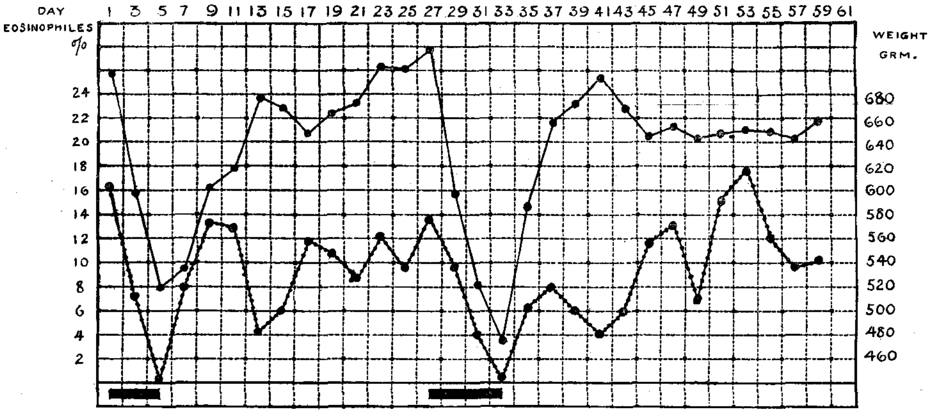
GUINEA-PIG B.

Day.	Weight, grm.	Leukocytes in 1 c.mm.	Eosinophiles in 1 c.mm.
1st	650	7,900	869 = 11.0 "
2d	615	12,900	1741 = 13.5 ,,
3d	579	12,000	840 = 7.0 "
4th	550	17,500	787 = 4.5 "
5th	526	10.900	414 = 3.8 "

In both experiments an increase in the relative and in the absolute number of eosinophile leukocytes preceded the fall, which began on the fourth day of starvation.

If food is withheld during several days, the animal may loose in weight 100 or more grams, and, gradually recovering, regain its former size only after several weeks. With the administration of food there is a sudden increase both of weight and of eosinophile leukocytes, but the increase of neither is uninterrupted. In the experiments recorded by the accompanying chart, withdrawal of food on two occasions, namely, from the first to the fifth days of observation, and again from the twenty-seventh to the thirty-third day, has been followed by a fall of eosinophile leukocytes to less than 1 per cent.

CHART 5.

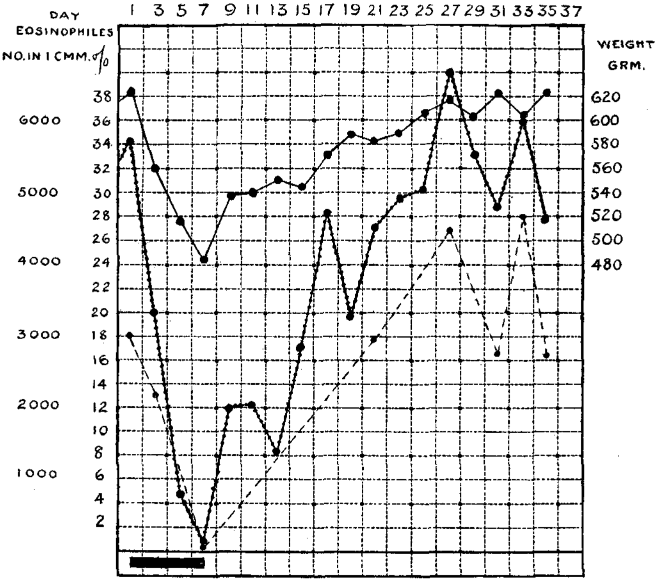


During the period which follows the administration of food the chart exhibits the phenomenon which has been noted in the normal animal. Increase in the proportion of eosinophile leukocytes is not continuous, and after two or three days their number falls, even though the weight, which is yet far from normal, continues to rise. Soon the increase of weight is interrupted, and with a fall in the curve of weight there is an increase in the proportion of eosinophile cells. This phenomenon is conspicuous during the first ten days or two weeks after starvation, but may be subsequently absent.

In the experiment recorded in Chart 6, an animal was employed of which the blood contained eosinophiles in the unusual proportion of 34 per cent.; the total number of leukocytes was, however, somewhat less than usual.

In this experiment the eosinophile leukocytes did not fall to 1 per cent. until the seventh day after food had been withdrawn; the weight diminished during this time 140 grams. The subsequent rise and fall of the curves representing weight and eosinophile cells show the remarkable relation previously observed, though the falls in weight on the nineteenth and again on the twenty-fifth day, with which in each case corresponds a sudden rise in the proportion of eosinophile cells, are so slight that they may be regarded as interruptions of the gradual return to normal. The total number of leukocytes was estimated at intervals, in order to determine the absolute number of eosinophile cells in one cubic millimetre of blood, but no important difference between the proportion and the absolute number of eosinophile leukocytes was observed. Particularly noteworthy is the fact that variations affecting the proportion of eosinophiles, and occurring between the thirty-first and thirty-ninth days, when the animal's weight had become normal, correspond to inverse variations of weight, and represent the absolute as well as the relative number of eosinophile cells.

CHART 6.



In three animals I have studied in sections from tissues hardened in Zenker's fluid the effect of starvation upon the distribution of the eosinophile cells. The weight, the percentage of eosinophile leukocytes at the beginning of the experiment, and the date of death were as follows:

No. 1.	Weight, 385 grm.	Percentage of eosinophiles, 0.3.	Killed on the 5th day.
" 2.	" 712 "	" " " 12.0.	" " 6th "
" 3.	" 650 "	" " " 11.0.	" " 8th ",

Except in the animal killed on the eighth day of starvation, there was no noteworthy diminution in the number of cells with eosinophile granulation in the wall of the small intestine, and especially in the Peyer's patches. On the eighth day, however, their number had appreciably diminished. In the mesenteric lymph glands and in the connective tissue of the mesentery and omentum, on the contrary, few such cells were found in any of the animals examined. The same statement can be made concerning the lungs where eosinophile cells are usually so abundant. The number in the spleen was much diminished, and, as usual, was in close relation with the number present in the blood.

In order to determine what changes have taken place in the bone-marrow, it is necessary to recall the fact that the number of eosinophile cells here present is variable and has a relation to the proportion of eosinophile leukocytes in the blood. In no case was a noteworthy diminution observed in this organ. In the animal killed on the fifth day, in which the eosinophile leukocytes at the beginning of the experiment numbered only 3 per cent., eosinophile cells were fairly abundant in the marrow and were, in great part, of small size, with polymorphous nuclei; myelocytes were not numerous. In the animals killed on the sixth and eighth days eosinophile cells were still present in great abundance, and smaller forms, resembling those usually found in the circulating blood, were far more numerous than myelocytes with eosinophile granulation. Particularly noteworthy is the fact that the eosinophile cells of the bone-marrow do not show the marked diminution which occurs in other organs.

ORIGIN OF THE EOSINOPHILE CELLS. Ehrlich has maintained that a sharp distinction can be drawn between the lymphocytes and the granular leukocytes; the former have their origin in the lymphatic glands and in other tissues which form part of the lymphatic system, while the latter are derived wholly from the bone-marrow. The great number of eosinophile cells present in the bone-marrow furnishes evidence, Ehrlich has maintained, that they here undergo multiplication. Other observers (Müller and Rieder) have suggested that their presence may be explained by supposing that the bone-marrow is a storehouse for eosinophile leukocytes.

Max Schultze, who, almost forty years ago, classified the leukocytes observable in fresh blood studied upon a warm stage, reached the conclusion that the amœboid cells containing coarse granules are derived by gradual transition from the amœboid leukocytes with fine granules and many subsequent writers, including Ouskow,[1] Zappert,[2] Müller and Rieder,[3] Gulland,[4] and Van der Stricht,[5] finding in human blood what they believe to be transitional stages, have maintained that leukocytes with eosinophile granulation are derived from those with fine neutrophile granules. The transformation, they think, occurs either in the bone-marrow or in the circulating blood.

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[1] From the Russian. Quoted by Ehrlich and Lazarus and others.

[2] Loc. cit.

[3] Loc. cit.

[4] Journal of Physiology, 1896, vol. xix. p. 385.

[5] Arch. de biol., 1892, vol. xii. p. 199.

To many observers the number of eosinophile leukocytes in the circulating blood has seemed too small to explain the large accumulations not infrequently noted in various organs. Ehrlich, indeed, reached the conclusion that the eosinophile cells of the frog are, in part at least, transformed cells of connective tissue. The presence of eosinophile cells in certain skin lesions has suggested to Neusser[1] and others that these cells in man may be formed in connective tissue. Certain writers, including von Leyden,[2] Schmidt,[3] and Grouven,[4] who have studied the eosinophile cells in the sputum and blood of patients suffering with asthma, claim that they are formed in the bronchial mucosa. Stutz[5] thinks that they may be formed in the intestinal mucosa as well. Howard and Perkins[6] believe that eosinophile cells are formed in various organs, especially in the lymphoid tissue of the gastrointestinal mucosa and in various exudations, from lymphocytes and from plasma cells, and state that transitions from one to the other may be observed.

According to another view, the eosinophile granules are formed from material ingested by leukocytes. In many instances this belief has had its chief support in the fact that the material supposed to form eosinophile granules stains deeply with acid dyes. Klein[7] thinks that neutrophile leukocytes take up hæmoglobin derived from extravasated red blood corpuscles and are transformed into eosinophile cells; Sacharoff[8] holds a somewhat similar view. Tettenhamer[9] has described the formation of eosinophile cells in the degenerate testicle of the salamander; acidophile substance formed from nuclei undergoing degeneration is ingested by phagocytes. In human muscle infected with trichinæ T. R. Brown[10] found both neutrophile and eosinophile leukocytes in contact with the substance of much-altered muscle fibres. Finding, in addition, what he regarded as transitional stages between the two varieties of cell, he thought it probable that the neutrophile leucocytes form eosinophile granules by ingesting material derived from the degenerate muscle fibres. He supported this view by observations upon the relation of the eosinophile and neutrophile cells of the circulating blood. When with trichinosis the eosinophile cells in the blood were very greatly increased, the neutrophile leukocytes had undergone a corresponding diminution in number.

Metschnikoff[11] and Mesnil[12] also believe that eosinophile cells may be formed by a process of phagocytosis. Metschnikoff has seen spirilla of cholera ingested by leukocytes of the guinea-pig become so altered that they stain readily with eosin, while Mesnil maintains that anthrax bacilli are transformed into eosinophile granules by leukocytes of the lizard.

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[1] Wiener klin. Woch., 1892, vol. v. pp. 41, 65.

[2] Deutsche med. Woch., 1891, vol. xvii. p. 1085.

[3] Zeit. f. klin. Med., vol. xx.

[4] Inaug. Diss., Bonn, 1895.

[5] Ibid.

[6] Johns Hopkins Hospital Reports, 1903, vol. x. p. 249.

[7] Cent. f. innere Med., 1899, vol. xx. pp. 97, 121.

[8] Cent. f. Bakt. u. Par., 1897, vol. xxi. p. 265.

[9] Anat. Anz., 1893, vol. viii. p. 223.

[10] Journal of Experimental Medicine, 1898, vol. iii. p. 315.

[11] Annales de l'Institut Pasteur, 1894, vol. viii. p. 58.

[12] Ibid., 1895, vol. ix. p. 301.

SUMMARY AND CONCLUSIONS. The opinions which have just been cited will not be discussed in detail. I will merely review certain facts which I believe serve to explain the origin of the eosinophile cells. In various tissues of the guinea-pig, notably in the mucosa of the gastrointestinal tract, in the mucosa of the air-passages, in the lymphatic tissue, and in the spleen, occur eosinophile leukocytes which are identical with those present in the circulating blood, and, like them, are provided with polymorphous nuclei. In the bone-marrow alone occur large mononuclear cells with eosinophile granulation. These cells of the bone-marrow undergo mitotic division and form daughter cells, which resemble in size the eosinophile leukocytes of the blood, while cells in which the nucleus presents varying irregularity in shape may be regarded as transitional forms. In the blood and in various organs the eosinophile cells give no evidence of multiplication.

The myelocytes with neutrophile or amphophile granules are analogous to the myelocytes with eosinophile granulation, resembling them in size and in the character of their nuclei. Muir[1] found that when the amphophile leukocytes in the blood of the rabbit undergo continued increase as the result of repeated bacterial infection, the myelocytes of the marrow are increased in number and mitotic division proceeds actively. An analogous phenomenon has been noted in those guinea-pigs of which the circulating blood contains a very large proportion of eosinophile leukocytes. The number of eosinophile cells is far greater than usual, while particularly abundant are the large eosinophile myelocytes. Mitotic division of these cells is observed much more readily than in the marrow of animals in which the blood contains few eosinophile leukocytes.

In certain instances in which eosinophile cells have accumulated in the tissues it has been possible to demonstrate their abundance in the bloodvessels of the part, and in one case the process of migration was actually demonstrable in sections of the hardened tissue. In apparently healthy guinea-pigs eosinophile leukocytes have been shown to migrate from the bloodvessels into the wall of a small bronchus, and hence through the epithelium into the lumen. Eosinophile cells manufactured in the bone-marrow reach the tissues by way of the bloodvessels.

The number of eosinophile cells in one cubic millimetre of blood is found to vary from day to day, and at intervals of three or four days undergoes an increase. It is not improbable that the number of eosinophile cells which the bone-marrow discharges into the circulation is subject to periodic variation. Complete withdrawal of food is followed by a decrease both in the proportion and in the absolute number of eosinophile leukocytes in the peripheral circulation. Disturbance of nutrition acting doubtless on the bone-marrow affects the multiplication of the eosinophile cells more readily than that of the polynuclear leukocytes with fine granulation. Diminution in the number of eosinophile cells is preceded by a temporary increase, which may be explained by supposing that ripe eosinophile leukocytes already stored in the marrow reach the circulation, and, perhaps, are no longer diverted to the intestinal mucosa. With the administration of food the eosinophile cells of the blood gradually increase in number, but neither the weight of the animal nor the eosinophile leukocytes increase continuously. That there exists a close relation between the nutrition of the animal and the eosinophile cells is shown by the fact that variations in weight and in the number of eosinophile cells take with much regularity opposite directions, so that a temporary fall in weight is accompanied by a rapid increase of the eosinophile leukocytes, while a rise in weight tends to retard this increase.

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[1] Journal of Pathology and Bacteriology, 1901, vol. vii. p. 161.

CIRCUMCORNEAL HYPERTROPHY (VERNAL CONJUNCTIVITIS) IN THE NEGRO.

By Swan M. Burnett, M.D., Ph.D.,
OF WASHINGTON, D. C.

It would seem from a report of the discussion of a most carefully prepared paper on "Vernal Conjunctivitis," read by Dr. W. C. Posey[1] at the last meeting of the American Medical Association, at New Orleans, that opinion is far from being settled as to the peculiar manifestations of this singular affection in the negro in this country. As some statements of mine in a paper published in Knapp's *Archives* in 1881, in which the phases of the disease as it appears in the negro were first brought to the attention of the profession, have apparently not been clearly understood or not confirmed by other observers, it may not be without interest to revert to the subject again in an endeavor to harmonize views and clarify some seeming obscurities.

It appears to be a question with some whether the appearances described in that paper, and also in my chapter on "Diseases of the Conjunctiva" in Norris and Oliver's *System,* are not those of phlyctenular conjunctivitis, instead of that distinct form of disease now generally denominated as "spring catarrh" of the conjunctiva.

A rather extensive study of the disease (principally by Europeans) since Sämisch first reported upon it in 1876 has not added greatly to

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[1] Published in Journal of the American Medical Association, July 25, 1903.